

Gulf Cooperation Council

EDICT OF GOVERNMENT

In order to promote public education and public safety, equal justice for all, a better informed citizenry, the rule of law, world trade and world peace, this legal document is hereby made available on a noncommercial basis, as it is the right of all humans to know and speak the laws that govern them.

GSO 60 (1987) (English): INDUSTRIAL SAFETY AND
HEALTH REGULATIONS HAZARDOUS MATERIALS — GASES —
PART 6: LIQUEFIED PETROLEUM GASES



BLANK PAGE



هيئة التقييس لدول مجلس التعاون دول الخليج العربية
STANDARDIZATION ORGANIZATION FOR G.C.C (GSO)



GSO 60/1987

اشتراطات السلامة والصحة الصناعية

المواد الخطرة – الغازات

الجزء السادس : الغازات البترولية المسالة

**INDUSTRIAL SAFETY AND HEALTH REGULATIONS
HAZARDOUS MATERIALS — GASES – PART 6:
LIQUEFIED PETROLEUM GASES**

ICS:13.100

**INDUSTRIAL SAFETY AND HEALTH REGULATIONS
HAZARDOUS MATERIALS — GASES – PART 6:
LIQUEFIED PETROLEUM GASES**

Date of GSO Board of Directors' Approval : 05-11-1407H (01-07-1987)
Issuing status : Technical Regulation

CONTENTS

1.	SCOPE AND FIELD OF APPLICATION	2
2.	COMPLEMENTARY REFERENCES	2
3.	REGULATIONS.....	3
3.1	General Requirements.....	3
3.2	Container System	14
3.3	Liquefied Petroleum Gas as a Motor Fuel	19
3.4	Storage of Containers Awaiting Use or Resale.....	24
3.5	LP-gas Used in Utility Plants	25

INDUSTRIAL SAFETY AND HEALTH REGULATIONS — GASES – PART 6: LIQUEFIED PETROLEUM GASES

1. SCOPE AND FIELD OF APPLICATION

- 1.1 This Standard is concerned with building fixed and portable containers of LPG and its distributing system, container valves and accessories, filling pipes and discharge pipes. It is also applicable to the following:
 - 1.1.1 Internal combustion engines, fuel containers and pertinent equipment for the use of liquefied petroleum gases as a motor fuel on easily movable, readily portable units including self-propelled vehicles.
 - 1.1.2 Storage of portable containers not in excess of 454 litres water capacity, filled or partially filled, at user location but not connected for use, or in storage for resale by dealers or resellers.
 - 1.1.3 Design, construction, location and operation of refrigerated and nonrefrigerated containers in utility plants.
 - 1.1.4 The appropriate provisions in the Gulf Standard mentioned in item 2.1 shall apply to all these equipment and locations.
- 1.2 This Standard is not applicable to the following:
 - 1.2.1 Liquefied petroleum gas when used with oxygen in welding and cutting (see the Gulf Draft Standard mentioned in item 2.2).
 - 1.2.2 Using of liquefied petroleum gases for marine purposes.

2. COMPLEMENTARY REFERENCES

- 2.1 GSO 55/1987 “Industrial Safety and Health Regulations - Hazardous Materials - Gases - Part 1: General Requirements”.
- 2.2 GSO 220/1994 “Industrial Safety and Health Regulations - Welding, Cutting and Brazing”.
- 2.3 GSO 59/1987 “Industrial Safety and Health Regulations - Hazardous Materials - Gases - Part 5: Ammonia”.
- 2.4 GSO 218/1994 “Industrial Safety and Health Regulations - Electrical Part 2: Low Voltage”.
- 2.5 GSO 57/1987 “Industrial Safety and Health Regulations - Hazardous Materials - Gases - Part 3: - Hydrogen”.
- 2.6 GSO 214/1994 “Industrial Safety and Health Regulations – Equipment - Materials Handling”
- 2.7 GSO 208/1994 “Industrial Safety and Health Regulations -Buildings - Part 2: Fire Protection”.

3. REGULATIONS

3.1 General Requirements

3.1.1 Odourizing Gases

3.1.1.1 All liquefied petroleum gases shall be effectively odourized by an agent of such character as to indicate positively, by distinct odour, the presence of gas down to concentration in air of not over one-fifth the lower limit of flammability. Odourization, however, is not required if harmful in the use of further processing of the liquefied petroleum gas, or if odourization will serve no useful purpose as a warning agent in such use or further processing.

3.1.1.2 The odourization requirement of item 3.1.1.1 shall be considered to be met by the use of 1 kg of ethyl mercaptan, 1 kg of thiophane or 1.4 kg of amyl mercaptan per 80,000 litres of LP gas. However, this listing of odourants and quantities shall not exclude the use of other odourants that meet the odourization requirements of item 3.1.1.1.

3.1.2 Approval of Equipment and Systems

3.1.2.1 Each system utilizing containers of 7500 litres or less water capacity, shall consist of a container assembly and one or more regulators, and may include other parts. Either the system as a unit shall be approved, or the container assembly as a unit and the regulator or regulators shall be individually approved

3.1.2.2 In systems utilizing containers of over 7500 litres water capacity, each regulator, container shall w valve, gauging device, and relief valve installed on or at the container, shall be approved by Standardization and Metrology Organization GCC Countries as a single operating unit.

3.1.3 Containers used with systems shall be designed, constructed, and marked in accordance with the Gulf Standard mentioned in item 2.1.

3.1.4 Location of containers and regulating equipment shall comply with the Gulf standard mentioned in item 2.1 and as follows:

3.1.4.1 Containers, and first stage regulating equipment shall comply with the Gulf standard mentioned in item 2.1 and as follows:

- a) In buildings used exclusively for container charging, vaporization, pressure reduction, gas mixing, gas manufacturing, or distribution.
- b) LP gas - fueled stationary or portable engines used in accordance with items 3.3.11 and 3.3.12.
- c) LP gas - fueled industrial trucks used in accordance with item 3.3.13.
- d) LP gas - fueled vehicles garaged in accordance with item 3.3.14.
- e) Containers awaiting use or resale when stored in accordance with item 3.4.

3.1.4.2 Each individual container shall be located with respect to the nearest important building or group of buildings which may be built in accordance with Table 1.

Table 1.

Water Capacity Per Container(Litres)	Minimum Distances (m)		
	Containers		Between Aboveground Containers
	Underground	Aboveground	
Less than 500	3	None	None
500 to 1000	3	3	1
1001 to 2000	3	3	1
2001 to 7500	7.5	7.5	1
7501 to 100000	15	15	1.5
100001 to 270000	15	23	1.5
270001 to 340000	15	30	¼ of sum of diameters of adjacent containers

Note: If the aggregate water capacity of a multi-container installation at a consumer site is 1901 litres or greater, the minimum distance shall comply with the appropriate portion of this table, applying the aggregate capacity rather than the capacity per container. If more than one installation is made, each installation shall be separated from other installations by at least 7.5 m. Do not apply the MINIMUM DISTANCES BETWEEN ABOVEGROUND CONTAINERS to such installations.

Note: The above distance requirements may be reduced to not less than 3 m for a single container of 4550 litres water capacity or less, providing such a container is at least 7.5 m from any other LP gas container of more than 500 litres.

Note: The above 3 m distance may be cancelled for LPG containers (tanks) till 2000 litres under the following conditions:

- a) The horizontal distance between the container, measured from safety valve and filling assembly; and any opening or spark source in the level or under the level of container in any neighboring building shall not be less than 3 m.
- b) The number of neighboring containers shall not be more than one.

- 3.1.4.3 Containers installed for use shall not be stacked one above the other.
- 3.1.4.4 In the case of buildings devoted exclusively to gas manufacturing and distributing operations, the distances required by Table 1 may be reduced provided that in no case shall containers of water capacity exceeding 1900 litres be located closer than 3 m to such gas manufacturing and distributing buildings.
- 3.1.4.5 Readily ignitable material such as weeds and long dry grass shall be removed within 3 m of any container.

* Modification No. (1) in 1994-11-16 issued in the 17th meeting of the Board of Directors.

- 3.1.4.6 The minimum separation between liquefied petroleum gas containers and flammable liquid tanks shall be 6 m. The foregoing provision shall not apply when LP gas containers of 500 litres or less capacity are installed adjacent to flammable liquids, having flash point at or above 60°C and below 93.3°C, tanks of 1000 litres or less capacity.
- 3.1.4.7 Suitable means shall be taken to prevent the accumulation of flammable liquids under adjacent liquefied petroleum gas containers, such as by diking, diversion curbs, or grading.
- 3.1.4.8 When dikes are used with flammable liquid tanks, no liquefied petroleum gas containers shall be located within the diked area.
- 3.1.5 Container valves and accessories shall be as per the Gulf Standard mentioned in item 2.1 and as follows:
 - 3.1.5.1 Working pressure of components shall be 1451 kPa.
 - 3.1.5.2 Provisions of the Gulf Standard mentioned in item 2.3 shall also apply.
 - 3.1.5.3 Excess flow valves shall be designed with a bypass, not to exceed a 1 mm diameter opening to allow equalization of pressures.
 - 3.1.5.4 Containers of more than 115 litres water capacity and less than 7500 litres water capacity, filled on a volumetric basis, shall be equipped for filling into the vapour space.
- 3.1.6 Piping, tubing, and fittings shall comply with the Gulf Standard mentioned in item 2.1 and as follows:
 - 3.1.6.1 Carbon steel, brass, copper, or alloy pipes may be used.
 - 3.1.6.2 Aluminium alloy pipe, if used, shall be protected from corrosion when in contact with other metals except galvanized steel, or its location is such that it could be repeatedly wetted by water, sewage, detergent, etc., or it passes through flooring, plaster, masonry, or insulation. Maximum aluminium pipe shall be limited to 2 cm and 102 kPa pressure. Aluminium alloy piping shall not be installed within 15 cm of the ground.
 - 3.1.6.3 Vapour piping operating at pressure over 863 kPa and all liquid piping shall be designed for 1451 kPa.
 - 3.1.6.4 Vapour piping operating below 863 kPa pressure shall be designed for 863 kPa.
 - 3.1.6.5 Tubing shall be seamless copper, brass, steel, or aluminium alloy.
 - 3.1.6.6 Aluminium tube shall be protected under corrosive conditions as described for piping.
 - 3.1.6.7 In systems where the gas in liquid form without pressure reduction enters the building, only heavy walled seamless brass or copper tubing with an internal diameter not greater than 2.4 mm and a wall thickness of not less than 1.2 mm shall be used. This requirement shall not apply to research and experimental laboratories or to separate fire stations housing internal combustion engines, and to commercial gas plants or bulk stations where containers are charged, nor to industrial vaporizer buildings or equipment under construction or undergoing major renovation.

- 3.1.6.8 Pipe joints may be screwed, flanged, welded, soldered, or brazed with a material having a melting point exceeding 500°C. Joints on seamless copper, brass, steel, or aluminium alloy gas tubing shall be made by means of approved gas tubing fittings, or soldered or brazed with a material having a melting point exceeding 500°C.
- 3.1.6.9 Pipe fittings operating at a pressure of 863 kPa or less, shall be designed for a pressure of at least 863 kPa. For operating pressures above 863 kPa, fittings shall be designed for a minimum 1451 kPa.
- 3.1.6.10 The use of threaded cast iron pipe fittings is prohibited. Threaded ductile or malleable iron fittings are acceptable. Aluminium alloy fittings shall be used with aluminium alloy pipe and tubing. Insulated fittings shall be used where aluminium alloy pipe or tubing connects with a dissimilar metal.
- 3.1.6.11 Strainers, regulators, meters, compressors, pumps, etc., are not to be considered as pipe fittings. This does not prohibit the use of malleable, nodular, or high strength gray iron for such equipment.
- 3.1.7 Hose Specifications
- 3.1.7.1 Hose shall be fabricated of materials that are resistant to the action of LP gas in the liquid and vapour phases. If wire braid is used for reinforcing the hose, it shall be of corrosion-resistant material such as stainless steel.
- 3.1.7.2 Hoses subject to container pressure shall be marked "LP-gas" or "LPG" at not greater than 3 m intervals.
- 3.1.7.3 Hoses subject to container pressure shall be designed for a bursting pressure of not less than 8630 kPa.
- 3.1.7.4 Hoses subjected to container pressure shall be approved.
- 3.1.7.5 Hose connections subject to container pressure shall be capable of withstanding, without leakage, a test pressure of not less than 2550 kPa.
- 3.1.7.6 Hose and hose connections on the low-pressure side of the regulator or the reducing valve shall be designed for a bursting pressure of not less than 863 kPa, or five times the set pressure of the relief devices protecting that portion of the system, whichever is higher.
- 3.1.7.7 Hoses may be used on the low-pressure side of regulators to connect to gas appliances under the following conditions:
- a) The appliances connected with the hose shall be portable and need a flexible connection.
 - b) For use inside buildings the hose shall be of a minimum practical length, but shall not exceed 2 m and shall not extend from one room to another, nor pass through any walls, partitions, ceilings, or floors. Such hose shall not be concealed from view or used in a concealed location. For use outside of buildings, the hose may exceed this length but shall be kept as short as practical.

- c) The hose shall be approved and shall not be used where it is likely to be subject to temperatures above 50°C. The hose shall be securely connected to the appliance and the use of the rubber slip ends shall not be permitted.
- d) The shut-off valve for an appliance connected by a hose shall be in the metal pipe or tubing and not at the appliance end of the hose.
- e) Hoses used for connecting to wall outlets shall be protected from physical damage.

3.1.8 Safety Devices.

Safety relief devices shall comply with the Gulf Standard mentioned in item 2.1 and as follows:

- 3.1.8.1 Each container and each vaporizer (except motor fuel vaporizers described in the Gulf Standard mentioned in item 2.1) shall be provided with spring - loaded safety valves or equivalent. These valves shall have a discharge of 1.5 m horizontally away from any building.

- 3.1.8.2 Minimum required rate of discharge in cu. m/min. of air at 120 percent of the maximum permitted start-to-discharge pressure for safety relief valves to be used on containers shall be determined as follows:

Flow rate in cu. m/min. of air = $10.66A^{(0.82)}$.

A = Total outside surface area of the container in sq. m.

Flow rate - cu m/min. of air = Required flow capacity in cu. m/hr of air at standard conditions.

- 3.1.8.3 The minimum required rate of discharge for safety relief valves shall be determined as follows:

- Obtain the total surface area by adding the surface area of vaporizer shell in sq. m directly in contact with LP-gas and the heat exchanged surface area in sq. m directly in contact with LP-gas.
- Obtain the minimum required rate of discharge in cu. m of air/min. from item 3.1.8.2, for this total surface area.

- 3.1.8.4 Each container safety relief valve used with systems covered by items 3.2 and 3.3 shall be plainly and permanently marked with the following:

- “Container Type” of the pressure vessel on which the valve is designed to be installed;
- The pressure in kPa at which the valve is set to discharge;
- The actual rate of discharge of the valve in cu. m/min. of air at standard conditions;
- The manufacturer's name and catalog number.

- 3.1.8.5 A thermal relief valve shall be installed between each pair of shut-off valves on liquefied petroleum gas/liquid piping so as to relieve into a safe atmosphere. The start-to-discharge pressure setting of such relief valves shall not be in excess of 3500 kPa. The minimum setting on relief valves installed in piping connected to the containers shall not be lower than 140 percent of the container relief valve

setting. Such a relief valve should not be installed in the pump discharge piping if the same protection can be provided by installing the relief valve in the suction piping. The start-to-discharge pressure setting of such a relief valve, if installed on the discharge side of a pump, shall be greater than the maximum pressure permitted by the recirculation device in the system.

- 3.1.8.6 The discharge from any safety relief device shall not terminate in or beneath any building, except relief devices on mobile equipment.
- 3.1.8.7 Container safety relief devices and regulator relief vents shall be located not less than 1.5 m in any direction from air openings into sealed combustion system appliances or mechanical ventilation air intakes.
- 3.1.9 Vaporizers except for less than 1 litre capacity shall have safety relief valve discharge rate determined per item 3.1.8.3.
- 3.1.10 Filling Densities
 - 3.1.10.1 All containers shall be filled according to the filling densities shown in Table 2.
 - 3.1.10.2 Portable containers such as, but not limited to, motor fuel containers on industrial and lift trucks covered in item 3.2, or containers recharged at the installation may be filled either by weight or by volume using a fixed length dip tube gauging device.

Table 2
Maximum Permitted Filling Density
Aboveground Containers

Specific Gravity at 15.6°C	0 to 4550 Litres Total Water Cap	Over 4550 Litres Total Water Cap	Underground Containers All Capacities
	Percent	Percent	Percent
0.496 – 0.503	41	44	45
0.504 – 0.510	42	45	46
0.511 – 0.519	43	46	47
0.520 – 0.527	44	47	48
0.528 – 0.536	45	48	49
0.537 – 0.544	46	49	50
0.545 – 0.552	47	50	51
0.553 – 0.560	48	51	52
0.561 – 0.568	49	52	53
0.569 – 0.576	50	53	54
0.577 – 0.584	51	54	55
0.585 – 0.592	52	55	56
0.593 – 0.600	53	56	57

- 3.1.11 LP-Gas in Buildings
 - 3.1.11.1 Gas may be piped into buildings at a pressure in excess of 138.3 kPa only if the buildings or separate areas thereof are used in accordance with this item.

The buildings, must be used exclusively to house equipment for vaporization, pressure reduction, gas mixing, gas manufacturing, or distribution, or to house internal combustion engines, industrial processes, research, and experimental laboratories, or equipment and processes using such gas and having similar hazards, or are buildings, structures, or equipment under construction or undergoing major renovation.

3.1.11.2 Liquid may be permitted in buildings as follows:

- a) Buildings, or separate areas of buildings, used exclusively to house equipment for vaporization, pressure reduction, gas mixing, gas manufacturing, or distribution, or to house internal combustion engines, industrial processes, research and experimental laboratories, or equipment and processes using such gas and having similar hazards; and when such buildings and equipment are constructed in accordance with this standard.
- b) Buildings, structures, or equipment under construction or undergoing major renovation provided that the temporary piping meets the following conditions:
 - 1- Liquid piping inside the building shall conform to the requirements of item 3.1.6, and shall not exceed 27 mm iron pipe size. Copper tubing with an outside diameter of 20 mm or less may be used. All such piping shall be protected against construction hazards. Liquid piping inside buildings shall be kept to a minimum. Such piping shall be securely fastened to walls or other surfaces so as to provide adequate protection from breakage and so located as to subject the liquid line to lowest ambient temperatures.
 - 2- A shut-off valve shall be installed in each intermediate branch line where it takes off the main line and shall be readily accessible. A shut-off valve shall also be placed at the appliance end of the intermediate branch line. Such shut-off valve shall be upstream of any flexible connector used with the appliance.
 - 3- Suitable excess flow valves shall be installed in the container outlet line supplying liquid LP-gas to the building, immediately downstream of each shut-off valve and where piping size is reduced and shall be sized for the reduced size piping.
 - 4- Hydrostatic relief valves shall be installed in accordance with item 3.1.8.5.
 - 5- The use of hose to carry liquid between the container and the building or at any point in the liquid line, except at the appliance connector, shall be prohibited.
 - 6- Release of fuel when any section of piping or appliances is disconnected shall be minimized by either using an approved automatic quick-closing coupling (a type closing in both directions when coupled in the fuel line), or closing the valve nearest to the

appliance and allowing the *appliance to operate until the* fuel in the line is consumed.

- 7- Portable containers shall not be taken into buildings except as provided in item 3.1.4.1.

- 3.1.12 Transfer of liquids shall comply with the Gulf Standard mentioned in item 2.1 and as follows:
- 3.1.12.1 Gas or liquid shall not be vented to the atmosphere to assist in transferring contents of one container to another container except that this shall not preclude the use of an approved pump utilizing LP-gas in the vapour phase as a source of energy and venting such gas to the atmosphere at a rate not to exceed that from a 3 mm diameter opening and provided that such venting and liquid transfer shall be located not less than 15 m from the nearest building.
- 3.1.12.2 Filling of fuel containers for industrial trucks or motor vehicles from industrial bulk storage containers shall be performed not less than 3 m from the nearest masonry-walled building or not less than 7.5 m from the nearest building or other construction and, in any event, not less than 7.5 m from any building opening.
- 3.1.12.3 Filling of portable containers, mounted on skids, shall be performed not less than 15 m from the nearest building.
- 3.1.12.4 The filling connection and the vent from the liquid level gauges in containers, filled at point of installation, shall not be less than 3 m in any direction from air openings into sealed combustion system appliances or mechanical ventilation air intakes.
- 3.1.12.5 Pumping systems, when equipped with a positive displacement pump, shall include a recirculating device which shall limit the differential pressure on the pump under normal operating conditions to the maximum differential pressure rating of the pump. The discharge of the pumping system shall be protected so that pressure does not exceed 863 kPa. If a recirculation system discharges into the supply tank and contains a manual shut-off valve, an adequate secondary safety recirculation system shall be incorporated which shall have no means of rendering it inoperative. Manual shut-off valves in recirculation systems shall be kept open except during an emergency or when repairs are being made to the system.
- 3.1.12.6 When necessary, unloading piping or hoses shall be provided with bleeder valves for relieving pressure before disconnection.
- 3.1.13 Tank car or transport truck, loading or unloading points and operations shall comply with the Gulf Standard mentioned in item 2.1.
- 3.1.14 Electrical equipment and other sources of ignition shall comply with the Gulf Standard mentioned in item 2.1 and as follows:
- 3.1.14.1 Liquefied petroleum gas storage containers do not require lightning protection.
- 3.1.14.2 Open flames (except as provided for in item 3.1.9), cutting or welding, portable electric tools, and extension lights capable of igniting LP-gas, shall not be

permitted within classified areas as specified in Table 3 unless the LP-gas facilities have been freed from all liquids and vapours, or special precautions observed under carefully controlled conditions.

- 3.1.15 Fixed electrical equipment and wiring installed within classified areas specified in Table 3 shall comply with Table 3 and shall be installed in accordance with the Gulf Standard mentioned in item 2.4. This provision does not apply to fixed electrical equipment at systems covered by item 3.2.
- 3.1.16 Liquid level gauging devices shall comply with the Gulf Standard mentioned in item 2.1 and as follows:
- 3.1.16.1 Each container shall also have a marking attached permanently to the liquid level gauge showing the percent full that will be shown by that gauge. If variable level gauge is provided, a fixed level gauge will serve for checking the variable gauge. These gauges shall be used for charging or filling containers.
- 3.1.16.2 All variable gauging devices shall be arranged so that the maximum liquid level to which the container may be charged is readily determinable for butane, for a 50-50 mixture of butane and propane, or for propane. The markings indicating the various liquid levels from empty to full shall be on the system nameplate or gauging device or part may be on the system nameplate and part on the gauging device. Dials of magnetic or rotary gauges shall show whether they are for cylindrical or spherical containers and whether for aboveground or underground service. The dials of gauges intended for use only on aboveground containers of over 4550 litres water capacity shall be so marked.

Table 3
Classification of Hazardous Areas

Location	Extent of Classified Area ⁽¹⁾	Equipment shall be suitable for Class 1 Group D Areas ⁽²⁾
Storage containers	Within 4.5 m in all directions from connections, except connections otherwise covered in this Table.	Division 2
Tank vehicle and tank car loading and unloading ⁽³⁾	Within 1.5 m in all direction from connection regularly made or disconnected for product transfer.	Division 1
	Beyond 1.5 m but within 4.5 m in all directions from a point where connections are regularly made or disconnected and within the cylindrical volume between the horizontal equator of the sphere and grade.	Division 2
Gauge vent openings on cylinders	Within 1.5 m in all direction from point of discharge	Division 1

Table 3 – (Continued)

Location	Extent of Classified Area ⁽¹⁾	Equipment shall be suitable for Class 1 Group D Areas ⁽²⁾
Relief valve discharge on cylinders	Beyond 1.5 m but within 4.5 m in all directions form point of discharge. Within direct path of discharge.	Division 2 Division 1 Note: Fixed electrical equipment should preferably not be installed.
Pumps, compressors, gas-air mixers and vaporizers other than direct fired	Within 1.5 m in all directions from point of discharge. Beyond 1.5 m but within 4.5 m in all directions form point of discharge except within the direct path of discharge.	Division 1 Division 2
Indoors without ventilation	Entire room and any adjacent room not separated by a gastight partition Within 4.5 m of the exterior side of any exterior wall or roof that is not vapourtight or within 4.5 m of any exterior opening	Division 1 Division 2
Indoors with adequate ventilation ⁽⁴⁾	Entire room and any adjacent room, not separated by a gastight partition.	Division 2
Outdoors in open air at or above-grade	Within 4.5 m in all directions from this equipment and within the cylindrical volume between the horizontal equator of the sphere and grade.	Division 2
Service station dispensing units	Entire space within dispenser enclosure, and 45 cm horizontally from enclosure, exterior up to an elevation 1.2 m above dispenser base. Entire pit or open space beneath dispenser. Up to 45 cm above grade within 6 m horizontally from any edge of enclosure.	Division 1 Division 2

Table 3 – (Continued)

Location	Extent of Classified Area ⁽¹⁾	Equipment shall be suitable for Class 1 Group D Areas ⁽²⁾
Pits or trenches containing or located beneath LP-gas valves, pumps, compressors, regulators, and similar equipment.		
Without mechanical ventilation	Entire pit or trench	Division 1
	Entire room and any adjacent room not separated by a gastight partition.	Division 2
	Within 4.5 m in all directions from pit or trench when located outdoors	Division 2
With adequate mechanical ventilation	Entire pit or trench	Division 2
	Entire room and any adjacent room not separated by a gastight partition	Division 2
	Within 4.5 m in all directions from pit or trench when located outdoors	Division 2
Special buildings or rooms for storage of portable containers	Entire room	Division 2
Pipelines and connections containing operational bleeds, drips, vents or drains.	Within 1.5 m in all directions from point of discharge	Division 1
Container filling: Indoors without ventilation	Entire room	Division 1
Indoors with adequate ventilation ⁽⁴⁾	Within 1.5 m in all directions from connections regularly made or disconnected for product transfer	Division 1
	Beyond 1.5 m and entire room	Division 2
Outdoors in open air	Within 1.5 m in all directions from connections regularly made or disconnected for product transfer.	Division 1
	Beyond 1.5 m but within 4.5 m in all directions from a point where connections are regularly made or disconnected and within the cylindrical volume between the horizontal equator of the sphere and grade.	Division 2

- 1) The classified area shall not extend beyond an unpierced wall, roof, or solid vapourtight partition.
 - 2) See the Gulf Standard mentioned in item 2.4.
 - 3) When classifying extent of hazardous area, consideration shall be given to possible variations in the spotting of tank cars and tank vehicles at the unloading points and the effect these variations of actual spotting points may have on the point of connection.
 - 4) Ventilation, either natural or mechanical, is considered adequate when the concentration of the gas in a gas-air mixture does not exceed 25 percent of the lower flammable limit under normal operating conditions.
- 3.1.16.3 Gauging devices shall have a design working pressure of 1765 kPa minimum.
- 3.1.16.4 Length of tube or position of fixed liquid-level gauge shall be designed to indicate the maximum level to which the container may be filled.
- The length of the fixed tube shall be such that when its lower end touches the surface of the liquid in the container, the contents of the container will be the maximum permitted volume as determined by Table 2.
- 3.1.16.5 Fixed liquid-level gauges used on containers shall be stamped on the exterior of the gauge with the letters "DT" followed by the vertical distance (expressed in cm) from the top of container to the end of the dip tube or to the centerline of the gauge when it is located at the maximum permitted filling level. For portable containers that may be filled in the horizontal and/or vertical position the letters "DT" shall be followed by "V" with the vertical distance from the top of the container to the end of the dip tube for vertical filling and with "H" followed by the proper distance for horizontal filling. On above ground or cargo containers where the gauges are positioned at specific levels, the marking may be specified in percent of total tank contents and stamped on the container.
- 3.1.16.6 Gauging devices of the float or similar type which do not require flow for their operation and having connections extending to a point outside the container do not have to be equipped with excess flow valves, provided that the piping and fittings are adequately designed to withstand the container pressure and are properly protected against physical damage and breakage.
- 3.1.16.7 Gauge glasses of the columnar type are prohibited on tank trucks and motor fuel tanks, and on containers used in industrial installations.
- 3.1.17 Except as provided in item 3.1.18 industrial gas consuming appliances shall be approved.
- 3.1.18 Any appliance that is originally manufactured for operation with a gaseous fuel other than LP-gas and is in good condition may be used with LP-gas only after it is properly converted, adapted, and tested for performance with LP-gas.
- 3.1.19 All industrial appliances or equipment shall be installed in accordance with the requirements of this item and good engineering practice.
- 3.2 Container Systems

- 3.2.1 Item 3.1 applies to this item unless otherwise noted.
- 3.2.2 Minimum design pressure of storage containers shall be 125 percent of maximum vapour pressure of the product at 45°C to be stored in the container.
- 3.2.3 Container Valves and Accessories, Filler Pipes, and Discharge Pipes
- 3.2.3.1 The filling pipe inlet terminal shall not be located inside a building. For containers with a water capacity of 475 litres or more, such terminals shall be located not less than 3 m from any building and preferably not less than 1.5 m from any driveway, and shall be located in a protective housing built for the purpose.
- 3.2.3.2 The filling connection shall be fitted with one of the following:
- Combination back-pressure check valve and excess flow valve.
 - One double or two single back-pressure check valves.
 - A positive shutoff valve, in conjunction with either: An internal back pressure valve, or an internal excess flow valve.
- 3.2.3.3 All openings in a container shall be equipped with approved automatic excess flow valves except the openings for filling, safety relief device, liquid level gauging device, or pressure gauge and shall comply with appropriate requirements for such openings.
- 3.2.3.4 An excess flow valve is not required in the withdrawal service line providing the following are complied with:
- Such systems' total water capacity does not exceed 7500 litres.
 - The discharge from the service outlet is controlled by a suitable manually operated shutoff valve which is: Screwed directly into the service outlet of the container; or is an integral part of a substantial fitting screwed into or on the service outlet of the container; or screwed directly into a substantial fitting screwed into or on the service outlet of the container. The shut-off valve shall be equipped with an attached handwheel or the equivalent. The controlling orifice between the contents of the container and the outlet of the shut-off valve shall not exceed 8 mm in diameter for vapour withdrawal systems and 3.2 mm in diameter for liquid withdrawal systems. An approved pressure-reducing regulator shall be directly attached to the outlet of the shut-off valve and is rigidly supported, or that an approved pressure-reducing regulator is attached to the outlet of the shut-off valve by means of a suitable flexible connection, provided that the regulator is adequately supported and properly protected on or at the tank.
- 3.2.3.5 All inlet and outlet connections except safety relief valves, liquid level gauging devices and pressure gauges on containers of 7500 litres water capacity, or more, and on any container used to supply fuel directly to an internal combustion engine, shall be labeled to designate whether they communicate with vapour or liquid space. Labels may be on valves.

- 3.2.3.6 In lieu of an excess flow valve, openings may be fitted with a quick-closing internal valve which, except during operating periods, shall remain closed. The internal mechanism for such valves may be provided with a secondary control which shall be equipped with a fusible plug (not over 104°C melting point) which will cause the internal valve to close automatically in case of fire.
- 3.2.3.7 Not more than two plugged openings shall be permitted on a container of 7500 litres or less water capacity.
- 3.2.3.8 Containers of 475 litres water capacity or more shall be provided with an approved device for liquid evacuation, the size of which shall be 2 cm minimum. A plugged opening will not satisfy this requirement.
- 3.2.4 Safety Devices
- 3.2.4.1 All safety devices shall comply with the Gulf Standard mentioned in item 2.1 and as follows:
- a) If desired, discharge lines from two or more safety relief devices located on the same unit, or similar lines from two or more different units, may be run into a common discharge header, provided that the cross-sectional area of such header be at least equal to the sum of the cross-sectional area of the individual discharge lines. and that the setting of safety relief valves are the same.
 - b) Each storage container of over 7500 litres water capacity shall be provided with a pressure gauge.
 - c) A final stage regulator of an LP-gas system (excluding any appliance regulator) shall be equipped on the low-pressure side with a relief valve. When a regulator or pressure relief valve is installed inside a building, the relief valve and the space above the regulator and relief valve diaphragms shall be vented to the outside air with the discharge outlet located not less than 1 m horizontally away from any opening into the building which is below such discharge. (These provisions do not apply to individual appliance regulators when protection is otherwise provided. In buildings devoted exclusively to gas distribution purpose, the space above the diaphragm need not be vented to the outside).
- 3.2.4.2 Safety devices for above ground containers shall be provided as follows:
- a) Containers of 4550 litres water capacity or less which may contain liquid fuel when installed above ground shall have: the rate of discharge determined by the formula in item 3.1.8; spring-loaded relief valve or valves sized for this discharge rate. In addition to the required spring-loaded relief valve(s), suitable fuse plug(s) may be used provided the total discharge area of the fuse plug(s) for each container does not exceed 16 sq. cm.
 - b) The fusible metal of the fuse plugs shall have a yield temperature of 98°C minimum and 104°C maximum. Relief valves and fuse plugs shall have direct communication with the vapour space of the container.

- c) On a container having water capacity greater than 475 litres, but not over 7500 litres, the discharge from the safety relief valves shall be vented away from the container vertically upwards and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. Suitable provision shall be made for draining condensate which may accumulate in the relief valve or its discharge pipe.
- d) On containers of 475 litres water capacity or less, the discharge from safety relief devices shall be located not less than 1.5 m horizontally away from any opening into the building below the level of such discharge.
- e) On a container having water capacity greater than 7500 litres, the discharge from the safety relief valves shall be vented away from the container vertically upwards to a point at least 2 m above the container, and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. Suitable provision shall be made so that any liquid or condensate that may accumulate inside of the safety relief valve or its discharge pipe will not render the valve inoperative. If a drain is used, a means shall be provided to protect the container, adjacent containers, piping, or equipment against impingement of flame resulting from ignition of product escaping from the drain.

3.2.4.3 On all containers which are installed underground and which contain no liquid fuel until buried and covered, the rate of discharge of the spring-loaded relief valve installed thereon may be reduced to a minimum of 30 percent of the rate of discharge calculated in accordance with item 3.1.8.2. Containers so protected shall not be uncovered after installation until the liquid fuel has been removed. Containers which may contain liquid fuel before being installed underground and before being completely covered with earth are to be considered above ground containers when determining the rate of discharge requirement of the relief valves.

3.2.4.4 On underground containers of more than 7500 litres water capacity, the discharge from safety relief devices shall be piped vertically and directly upward to a point at least 2 m above the ground.

Where there is a probability of the manhole or housing becoming flooded, the discharge from regulator vent lines shall be above the highest probable water level. All manholes or housings shall be provided with ventilated louvers or their equivalent, the area of such openings equaling or exceeding the combined discharge areas of the safety relief valves and other vent lines which discharge their content into the manhole housing.

3.2.4.5 Safety devices for vapourizers shall be provided as follows:

- a) Vapourizers of less than 1 litre total capacity, heated by the ground or the surrounding air, need not be equipped with safety relief valves provided

that certified tests demonstrate that the assembly is safe without safety relief valves.

- b) No vapourizer shall be equipped with fusible plugs.
 - c) In industrial and gas manufacturing plants, safety relief valves on vapourizers within a building shall be piped to a point outside the building and discharged upward.
- 3.2.5 A single storage container shall not exceed 340,000 litres water capacity.
- 3.2.6 Installation of storage containers shall be according to the Gulf Standard mentioned in item 2.5.
- 3.2.7 Protection of container accessories shall be according to the Gulf Standard mentioned in item 2.1.
- 3.2.8 Where vapourized gas on the low-pressure side of the system may condense to a liquid at normal operating temperatures and pressures, suitable means shall be provided for revapourization of the condensate.
- 3.2.9 When damage to LP-gas systems from vehicular traffic is a possibility, precautions against such damage shall be taken.
- 3.2.10 Every effort shall be made to avoid the use of pits, except pits fitted with automatic flammable vapour detecting devices. No drains or blow-off lines shall be directed into or in proximity to sewer systems used for other purposes.
- 3.2.11 General Provisions Applicable to Systems in Industrial Plants (of 7500 Litres Water Capacity and More) and to Bulk Filling Plants:
- 3.2.11.1 When watch service is provided, it shall be extended to the LP-gas installation by personnel properly trained.
 - 3.2.11.2 If loading and unloading are normally done during other than daylight hours, lights shall be provided to illuminate storage containers, control valves, and other equipment.
 - 3.2.11.3 Roadways or means of access shall be provided with extinguishing equipment such as wheeled extinguishers or fire department apparatus.
 - 3.2.11.4 To minimize trespassing or tampering, the area which includes container appurtenances, pumping equipment, loading and unloading facilities, and cylinder-filling facilities shall be enclosed with at least a 1.8 m high industrial type fence unless otherwise protected. There shall be at least two means of emergency access.
- 3.2.12 Container-Charging Plants
- 3.2.12.1 The container-charging room shall be located not less than 3 m from bulk storage containers.
 - 3.2.12.2 Tank truck filling station outlets shall be located not less than 3 m from pumps and compressors if housed in one or more separate buildings.
 - 3.2.12.3 The pumps or compressors may be located in the container-charging room or building, in a separate building, or outside of buildings. When housed in a

separate building, such building (a small noncombustible weather cover is not to be constructed as a building) shall be located not less than:

- 3 m from bulk storage tanks;
- 7.5 m from sources of ignition.

- 3.2.12.4 When a part of the container-charging building is to be used for a boiler room or where open flames or similar sources of ignition exist or are employed, the space to be so occupied shall be separated from container charging room by a partition wall or walls of fire-resistant construction continuous from floor to roof or ceiling. Such separation walls shall be without openings and shall be joined to the floor, other walls, and ceiling or roof in a manner to effect a permanent gas-tight joint.
- 3.2.12.5 Electrical equipment and installations shall conform to items 3.1.14 and 3.1.15.
- 3.2.13 Each bulk plant shall be provided with at least one approved portable/mobile fire extinguisher having a B-C rating, with a capacity suitable to the capacity of the plant.
- 3.2.14 In installations involving containers of 570,000 litres aggregate water capacity or more, provision shall be made for fire protection in the container area, unless other means for fire control are provided. Water hydrants shall be readily accessible and so spaced as to provide water protection for all containers. It is desirable to equip the outlet of each hose line with a combination fog nozzle. A shelter shall be provided to protect the hose and its conveyor from the weather.
- 3.2.15 Above ground containers shall be kept painted.
- 3.2.16 Electrical equipment and installations shall conform to items 3.1.14 and 3.1.15.
- 3.2.17 Vapourizers for internal combustion engines, provisions of item 3.3.8 shall apply.
- 3.2.18 Gas regulating and mixing equipment for internal combustion engines, provisions of item 3.3.9 shall apply.
- 3.3 Liquefied Petroleum Gas as a Motor Fuel
- 3.3.1 General Requirements
- 3.3.1.1 Fuel may be used from the cargo tank of a truck while in transit, but not from cargo tanks on trailers or semitrailers. The use of fuel from the cargo tanks to operate stationary engines is permitted providing wheels are securely blocked.
- 3.3.1.2 Fuel tanks on passenger-carrying vehicles shall not be filled while passengers are on board, but fuel tanks may be exchanged.
- 3.3.1.3 Industrial trucks (including lift trucks) equipped with permanently mounted fuel containers shall be charged outdoors. Charging equipment shall comply with the requirements of good engineering practice.
- 3.3.1.4 Engines on vehicles shall be shutdown while fueling.

3.3.2 Design of Fuel Containers

Containers shall be designed in accordance with the Gulf Standard mentioned in item 2.1. Design pressure shall be at least 1863 kPa except for fuel containers used in industrial trucks (including fork lift trucks), it shall be 2158 kPa.

All container inlets and outlets except safety relief valves and gauging devices shall be labeled to designate whether they communicate with vapour or liquid space. Labels may be on valves.

3.3.3 Installation of Fuel Containers

3.3.3.1 Containers shall be located in a place and in a manner to minimize the possibility of damage to the container. Containers located in the rear of trucks, when protected by substantial bumpers, will be considered in conformance with this requirement. The container compartment shall be vented to the outside. In case the fuel container is mounted near the engine or the exhaust system, the container shall be shielded against direct heat radiation.

3.3.3.2 Containers shall be installed with as much clearance as practicable but never less than the minimum road clearance of the vehicle under maximum spring deflection. This minimum clearance shall be to the bottom of the container or to the lowest fitting on the container or housing, whichever is lower.

3.3.3.3 Permanent and removable fuel containers shall be securely mounted to prevent jarring loose, slipping, or rotating, and the fastenings shall be designed and constructed to withstand static loading in any direction equal to twice the weight of the tank and attachments when filled with fuel using a safety factor of not less than four based on the ultimate strength of the material to be used. Field welding, when necessary, shall be made only on saddle plates, lugs or brackets, originally attached to the container by the tank manufacturer.

3.3.3.4 Containers from which vapour only is to be withdrawn shall be installed and equipped with connections to minimize the accidental withdrawal of liquid.

3.3.4 Valves and Accessories

3.3.4.1 Container valves and accessories shall have a rated working pressure of at least 1765 kPa and shall be of a type suitable for liquefied petroleum gas service.

3.3.4.2 The filling connection shall be fitted with an approved double back-pressure check valve, or a positive shut-off in conjunction with an internal back-pressure check valve. On a removable container the filler valve may be a hand-operated shut-off valve with an internal excess flow valve. Main shut-off valves on the container on liquid and vapour lines must be accessible.

3.3.4.3 Filling connections equipped with approved automatic back-pressure check valves, safety relief valves and all connections to containers having openings for the flow of gas in excess of a 1.5 mm diameter size shall be equipped with approved automatic excess flow valves to prevent discharge of content if connections are broken.

3.3.5 Liquid-Level Gauging Devices

3.3.5.1 Variable liquid-level gauges which require the venting of fuel to the atmosphere shall not be used on fuel containers of industrial trucks (including lift trucks).

3.3.5.2 On portable containers that may be filled in the vertical and/or horizontal position, the fixed liquid-level gauge must indicate maximum permitted filling level for both vertical and horizontal filling with the container oriented to place the safety relief valve in communication with the vapour space.

3.3.5.3 All valves and connections on containers shall be protected to prevent damage due to accidental contact with stationary objects or from loose objects thrown up from the road, and all valves shall be safeguarded against damage due to collision, overturning or other accidents. However, on removable-type containers, the protection for the fittings shall be permanently attached to the container.

3.3.5.4 Exchange of removable fuel containers preferably shall be done outdoors. When removable fuel containers are used, means shall be provided in the fuel system to minimize the escape of fuel when the containers are exchanged. This may be accomplished by either of the following methods:

Using an approved automatic quick-closing coupling (a type closing in both directions when uncoupled) in the fuel line, or

Closing the valve at the fuel container and allowing the engine to run until the fuel in the line is consumed.

3.3.6 Piping, Tubing, and Fittings

3.3.6.1 Pipes from fuel container to first-stage regulator shall be wrought iron or steel (black or galvanized), brass, or copper; or seamless copper, brass, or steel tubing. Steel pipes or tubing shall be protected against exterior corrosion. Aluminium piping and tubing shall not be used. Approved flexible connections may be used between container and regulator or between regulator and gas-air mixer within the limits of approval. In the case of removable containers an approved flexible connection shall be used between the container and the fuel line.

3.3.6.2 All piping shall be installed, braced, and supported so as to reduce to a minimum the possibility of vibration strains or wear.

3.3.7 Safety Devices

3.3.7.1 Spring-loaded internal type safety relief valves shall be used on all motor fuel containers.

3.3.7.2 The discharge outlet from safety relief valves shall be located on the outside of enclosed spaces and as far as practicable from possible sources of ignition, and vented upward within 45 degrees of the vertical in such a manner as to prevent impingement of escaping gas upon containers, or parts of vehicles, or on vehicles in adjacent lines of traffic. A rain cap or other protector shall be used to keep water and dirt from collecting in the valve.

- 3.3.7.3 When a discharge line from the container safety relief valve is used, the line shall be metallic, other than aluminium, and shall be sized, located, and maintained so as not to restrict the required flow of gas from the safety relief valve. Such discharge line shall be able to withstand the pressure resulting from the discharge of vapour when the safety relief valve is in the full open position. When flexibility is necessary, flexible metal hose or tubing shall be used.
- 3.3.7.4 Portable containers equipped for volumetric filling, may be filled in either the vertical or horizontal position only when oriented to place the safety relief valve in communication with the vapour space.
- 3.3.7.5 Item 3.1.8.5 for thermal relief valves shall apply.
- 3.3.8 Vapourizers
- 3.3.8.1 Vapourizers and any part thereof and other devices that may be subjected to container pressure shall have a design pressure of at least 1765 kPa.
- 3.3.8.2 Each vapourizer shall have a valve or suitable plug which will permit substantially complete draining of the vapourizer. It shall be located at or near the lowest portion of the section occupied by the water or other heating medium.
- 3.3.8.3 Vapourizers shall be securely fastened so as to minimize the possibility of becoming loosened.
- 3.3.8.4 Each vapourizer shall be permanently marked at a visible point as follows:
- With the design pressure of the fuel containing portion in kPa.
 - With the water capacity of the fuel containing portion of the vapourizer in litres.
- 3.3.8.5 Devices to supply heat directly to a fuel container shall be equipped with an automatic device to cut off the supply of heat before the pressure inside the fuel container reaches 80 percent of the start-to-discharge pressure setting of the safety relief device on the fuel container.
- 3.3.8.6 Engine exhaust gases may be used as a direct source of heat supply for the vapourization of fuel if the construction materials of those parts of the vapourizer in contact with exhaust gases are resistant to the corrosive action of exhaust gases and the vapourizer system is designed to prevent excessive pressures.
- 3.3.9 Gas Regulating and Mixing Equipment
- 3.3.9.1 Approved automatic pressure reducing equipment shall be installed in a secure manner between the fuel supply container and gas-air mixer for the purpose of reducing the pressure of the fuel delivered to the gas-air mixer.
- 3.3.9.2 An approved automatic shut-off valve shall be provided in the fuel system at some point ahead of the inlet of the gas-air mixer, designed to prevent flow of fuel to the mixer when the ignition is off and the engine is not running. In the case of industrial trucks and engines operating in buildings other than those

used exclusively to house engines, the automatic shut-off valve shall be designed to operate if the engine should stop. Atmospheric type regulators (zero governors) shall be considered adequate as an automatic shut-off valve only in cases of outdoor operation such as, construction equipment, irrigation pump engines, and other outdoor stationary engine installations.

- 3.3.9.3 The sources of the air for combustion shall be completely isolated from the passenger compartment, ventilating system, or air-conditioning system.
- 3.3.10 No single fuel container on vehicles normally operating on highways shall exceed 1135 litres water capacity except as provided in item 3.3. 1. 1.
- 3.3.11 Stationary engines and gas turbines installed in buildings, including portable engines used instead of or to supplement, stationary engines, shall comply with the relevant Gulf Standard and the appropriate provisions of items 3.1 and 3.2.
- 3.3.12 Portable Engines in Buildings
 - 3.3.12.1 Portable engines may be used in buildings only for emergency use, except as provided by item 3.3.1 1.
 - 3.3.12.2 Exhaust gases shall be discharged to outside the building or to an area where they will not constitute a hazard.
 - 3.3.12.3 Provision shall be made to supply sufficient air for combustion and cooling.
 - 3.3.12.4 An approved automatic shut-off valve shall be provided in the fuel system ahead of the engine, designed to prevent flow of fuel to the engine when the ignition is off or if the engine should stop.
- 3.3.13 Industrial Trucks Inside Buildings
 - 3.3.13.1 LP-gas fueled industrial trucks are permitted to be used in buildings and structures in accordance with the Gulf Standard mentioned in item 2.6.
 - 3.3.13.2 No more than two LP-gas containers shall be used on an industrial truck for motor fuel purposes.
 - 3.3.13.3 LP-gas fueled industrial trucks are permitted to be used in buildings frequented by the public, when occupied by the public. The total water capacity of containers on each industrial truck shall not exceed 48 kg (nominal 20.5 kg LP-gas).
 - 3.3.13.4 Trucks shall not be left unattended in areas occupied by the public.
 - 3.3.13.5 Industrial trucks shall not be parked and left unattended in areas of possible excessive heat or sources of ignition.
- 3.3.14 Garaging LP-gas-Fueled Vehicles
 - 3.3.14.1 LP-gas-fueled vehicles may be stored or serviced inside garages provided there are no leaks in the fuel system and the fuel tanks are not filled beyond the maximum filling capacity specified in item 3. 1. 1 0. 1.
 - 3.3.14.2 LP-gas-fueled vehicles being repaired in garages shall have the container shut-off valve closed except when fuel is required for engine operation.

- 3.3.14.3 Such vehicles shall not be parked near sources of heat, open flames, or similar sources of ignition or near open pits unless such pits are ventilated.
- 3.4 Storage of Containers Awaiting Use or Resale
- 3.4.1 General Requirements
- 3.4.1.1 Containers in storage shall be located so as to minimize exposure to excessive temperature rise, physical damage, or tampering by unauthorized persons.
- 3.4.1.2 Containers when stored inside shall not be located near exits, stairways, or in areas normally used or intended for the safe exit of people.
- 3.4.1.3 Container valves shall be protected while in storage as follows:
- By setting into recess of container to prevent the possibility of their being struck if the container is dropped upon a flat surface, or
 - By ventilated cap or collar, fastened to container capable of withstanding a blow from any direction equivalent to that of a 14 kg weight dropped from a height of 1.2 m. Construction must be such that a blow will not be transmitted to a valve or other connection.
- 3.4.1.4 The outlet valves of containers in storage shall be closed.
- 3.4.1.5 Empty containers which have been in LP-gas service shall preferably be stored in the open. When stored inside, they shall be considered as full containers for the purpose of determining the maximum quantity of LP-gas permitted by this item.
- 3.4.2 Storage Within Buildings not Frequented by the Public (Such as Industrial Buildings)
- 3.4.2.1 The quantity of LP-gas stored shall not exceed 136 kg (approximately 72 cu. m in vapour form) except as provided in item 3.4.5.
- 3.4.2.2 Containers carried as a part of service equipment on highway mobile vehicles are not to be considered in the total storage capacity in the above item, provided that such vehicles are stored in private garages, and are limited to one container per vehicle with an LP-gas capacity of not more than 45 kg. All container valves shall be closed.
- 3.4.3 Storage Within Special Buildings or Rooms
- 3.4.3.1 The quantity of LP-gas stored in special buildings or rooms shall not exceed 4540 kg.
- 3.4.3.2 The walls, floors, and ceiling of container storage rooms that are within or adjacent to other parts of the building shall be constructed of a material having at least a 2 hour fire resistance rating.
- 3.4.3.3 A portion of the exterior walls or roof having an area not less than 10 percent of that of the combined area of the enclosing walls and roof shall be of explosion relieving construction.

- 3.4.3.4 Each opening from such storage rooms to other parts of the building shall be protected by $\frac{1}{2}$ - 1 hour fire door as per the Gulf Standard mentioned in item 2.7.
- 3.4.3.5 Such rooms shall have no open flames for heating or lighting.
- 3.4.3.6 Such rooms shall be ventilated both top and bottom to the outside only. The openings from such vents shall be at least 1.5 m away from any other opening into any building.
- 3.4.3.7 The floors of such rooms shall not be below ground level. Any space below the floor shall be of solid fill or ventilated to the open air.
- 3.4.3.8 Fixed electrical equipment shall be installed in accordance with item 3.1.15.
- 3.4.4 Storage Outside of Buildings
- 3.4.4.1 Storage outside of buildings, for containers awaiting use or resale shall be located in accordance with Table 4 with respect to buildings or the line of adjoining property.
- 3.4.4.2 Containers shall be in a suitable enclosure or otherwise protected against tampering.
- 3.4.5 Fire Protection
- Storage locations other than supply depots separated and located apart from dealer, reseller, or user establishments shall be provided with at least one approved portable/mobile fire extinguisher having a B-C rating.

Table 4

Quantity of LP-gas Stored (kg)	Distance (m)
200 or less	0
201 to 1100	0*
1101 to 2700	3
2701 to 4500	6.0
Over 4501	7.5

* Container or containers shall be at least 3 m from any building on adjoining property, any sidewalk, or any of the exposures described in item 3.4.4. 1.

- 3.5 LP-gas Used in Utility Plants
- 3.5.1 The appropriate provision in the Gulf Standard mentioned in item 2.1 and also in item 3.1 shall apply to this item with modifications and exceptions as noted in this item.
- 3.5.2 Odorizing Gases: Conditions of item 3.1.1 shall apply.
- 3.5.3 Approval of Equipment: Conditions of item 3.1.2 shall apply.
- 3.5.4 Container Valves and Accessories: Container valves and accessories shall comply with item 3.1.5 except as noted below.

- 3.5.4.1 Except as provided in item 3.1.6.4, all liquid and vapour connections on containers except safety relief connections shall be equipped with approved automatic excess flow valves or with back-pressure check valves, or a remotely-controlled automatic quick-closing valve which shall remain closed except during operating periods. The mechanism of remotely-controlled quick-closing valves shall be provided with secondary control equipped with a fusible release (not over 104°C melting point) which will cause quick-closing valve to close automatically in case of fire.
- 3.5.4.2 Each storage container shall be provided with a suitable pressure gauge.
- 3.5.4.3 All inlet and outlet connections except safety relief valves, pressure gauges, and liquid-level gauges on any container, shall be marked to designate whether they are connected to vapour or liquid space. Marking is permitted to be on valves.
- 3.5.5 Filler and Discharge Pipes, Manifolds
- 3.5.5.1 Piping connections between container and manifold shall be installed in accordance with the Gulf Standard mentioned in item 2. 1.
- 3.5.5.2 Compression fitting on tubing shall not be used.
- 3.5.5.3 Pipe inlet terminal shall be labelled to designate its purpose.
- 3.5.5.4 Non-metallic hose for connecting stationary containers shall be prohibited.
- 3.5.5.5 Where practical, liquid manifold connections shall be located at non adjacent ends of parallel rows of containers.
- 3.5.5.6 Automatic or remote control of fail safe type shut-off valves shall be provided in liquid lines to prevent discharge of liquid in case of line failure. The mechanism of such valves shall be provided with fusible release (not over 104°C melting point) which will cause valves to close in case of fire. At the location of installation such valves shall also be capable of manual operation. Such valves within 90 m of important structures shall limit discharge of liquid to a maximum of 8500 litres. When the line is within 90 m of important structure, the distance between such valves shall be no more than 45 m.
- 3.5.5.7 In addition to above valving, suitable safeguards shall be provided to prevent uncontrolled discharge of LP-gas in the event of failure in the flexible connecting hose or swivel type piping. The safeguards shall be located as close as practicable to the points where connections are made between the flexible and fixed parts of the piping system as follows:
- 3.5.5.7.1 The connection or connecting piping into which the liquid or vapour is being transferred shall be equipped with a backflow valve, or an excess flow valve.
- 3.5.5.7.2 The connection or connecting piping front which the liquid or vapour is being withdrawn shall be equipped with an excess flow valve.
- 3.5.5.7.3 When liquid line manifold connecting containers in a group with volumetric capacity of 380 litres or more, the container manifold shall be located at a minimum distance of 30.5 m from the nearest adjacent property.

- 3.5.6 Liquid Level Gauging Device
 - 3.5.6.1 Each non-refrigerated and refrigerated storage system shall be equipped with an approved liquid level gauging device.
 - 3.5.6.2 Pressure differential type, float gauge, rotary gauge, slip tube, magnetic or fixed tube device may be used. When float type or pressure differential type devices are used, the non-refrigerated container shall also be equipped with auxiliary devices such as fixed dip tube, slip tube, or rotary gauge. Auxiliary gauging device is not required for refrigerated containers.
 - 3.5.6.3 If refrigerated containers are subject to overfilling, they shall be equipped with automatic interrupting devices.
 - 3.5.6.4 Gauging devices shall have a maximum allowable working pressure at least equal to that of the containers to which they are attached.
- 3.5.7 Safety Devices
 - Safety devices shall comply with item 3.1.8 and as follows:
 - 3.5.7.1 Discharge lines from two or more relief devices located on the same unit, or similar lines from two or more different units, except those located on storage containers, are permitted to run into a common discharge header provided the header is designed with a flow capacity sufficient to limit the maximum back-pressure to: (a) not exceeding 10 percent of the lowest start-to-discharge pressure setting for conventional relief valves, and (b) not exceeding 50 percent of the lowest start-to-discharge pressure setting for balanced valves. The header design shall assume that all valves connected to the header are discharging at the same time.
 - 3.5.7.2 Vapourizers shall be provided with means for turning off the gas to the main burner and pilot from a remote location. The vapourizer shall also be equipped with automatic safety devices to shut off the flow to main burner if the ignition device should fail.
- 3.5.8 Piping, tubing and fittings shall be in accordance with the Gulf Standard mentioned in item 2. 1.
- 3.5.9 Hoses shall comply with item 3.1.7 except as noted.
 - 3.5.9.1 Minimum bursting pressure for hoses shall be 11769 kPa. Design working pressure shall be 2354 kPa.
 - 3.5.9.2 Hose assemblies shall withstand a test pressure of 4708 kPa.
- 3.5.10 Vapourizers
 - 3.5.10.1 Indirect fired vapourizers shall comply with the Gulf Standard mentioned in item 2.1.
 - 3.5.10.2 Direct fired vapourizers shall comply with the Gulf Standard mentioned in item 2.1.
 - 3.9.10.3 No direct fired vapourizers shall be connected to a container that has a storage capacity less than 10 times the hourly capacity of the vapourizer. No direct

- fired vapourizers shall be located closer than 15 m from the line of adjoining property and any LP-gas storage containers.
- 3.5.10.4 Vapourizers may be installed in buildings, rooms, housings, sheds, etc., and constructed as specified in the Gulf Standard mentioned in item 2.1. Rate of ventilation shall be 0.3cu. m/min./sq. m of floor area.
- 3.5.11 Gas Air Mixers
- 3.5.11.1 Gas-air mixers shall be equipped with safety interlocks on both LP-gas and air supply lines. Gas mixing control valves when actuated by safety interlocks shall be of acceptable shutdown device. Such valves shall fail in closed position.
- 3.5.11.2 Check valves or other means to prevent gas flow into air lines shall be provided in the air line near the mixer.
- 3.5.11.3 Means shall be provided to prevent air from entering mixed gas lines without LP-gas in the line.
- 3.5.11.4 Interlock shall be provided to prevent LP-gas liquid from entering the gas air mixer when condensation is a possibility between vapourizer and mixer. This interlock shall be thermally actuated, liquid level actuated or by any other actuator proved effective.
- 3.5.11.5 Gas air mixers which utilize the kinetic energy of the LP-gas vapour to entrain air from atmosphere and are so designed that maximum air entrainment is less than 85 percent of the mixture, need not be interlock but shall have a check valve in air line.
- 3.5.11.6 Gas air mixers shall be installed in special rooms or special areas constructed and ventilated, as specified in item 3.5.10.4.
- 3.5.12 Electric equipment and source of ignition and fixed electric equipment in classified areas shall be in accordance with item 3.1.14.
- 3.5.13 Filling Densities
- The filling density for containers shall comply with item 3.1.10.1.
- 3.5.14 Protection of container appurtenances shall comply with the Gulf Standard mentioned in item 2. 1.
- 3.5.15 Transfer of Liquid Within Utility Plants
- 3.5.15.1 Within utility buildings, transfer can be made by pressure differential or pump.
- 3.5.15.2 The appropriate provision in the Gulf Standard mentioned in item 2.1 shall apply to this subject.
- 3.5.15.3 Unloading piping or hoses shall be provided with suitable bleeder valves or other means for relieving pressure before disconnection.
- 3.5.16 Design, construction, and marking of containers shall comply with the Gulf Standard mentioned in item 2.1 and as follows:

- 3.5.16.1 Field erected containers for nonrefrigerated storage shall have design pressure of 125 percent of the maximum vapour pressure of the product at (45°C) to be stored in container but in no case it shall not be less than 196 kPa.
- 3.5.16.2 Field erected containers for refrigerated storage shall be designed as an integral part of the storage system including tank, insulation, compressors, condensers, control, and piping.
- 3.5.17 Location of refrigerated and non-refrigerated containers shall comply with the Gulf Standard mentioned in item 2.1 and as follows:
 - 3.5.17.1 Aboveground
 - Containers shall be located outside of buildings.
 - 3.5.17.2 Distances between containers and distance of container from adjoining property that may be built upon shall be as per Table 1.
 - 3.5.17.3 Container or containers with aggregate water capacity in excess of 454 cu. m shall be located 30.5 m from plants occupied for generation, compression, or purification of LP-gas or manufacture of LN-gas, or from outdoor installations essential for maintenance and operation.
 - 3.5.17.4 If container or containers of LP-gas are located closer than 30.5 m or the distances in Table 1 from plant as described above, they shall be separated by appropriate means such as firewalls.
 - 3.5.17.5 Nonrefrigerated containers shall not be located within dikes enclosing flammable liquid tanks or refrigerated LP-gas.
 - 3.5.17.6 Containers shall not be installed one above the other.
 - 3.5.17.7 There shall be no readily ignitable material within 7.5 m.
 - 3.5.17.8 Containers connected by some manifolds shall be at the same level.
- 3.5.18 Underground Containers – Nonrefrigerated.
 - 3.5.18.1 Underground containers shall be located outside of buildings.
 - 3.5.18.2 Sides of adjacent containers shall be 1 m apart.
 - 3.5.18.3 There shall be no roadways over them.
 - 3.5.18.4 Container rows shall be 3 m apart from one another.
 - 3.5.18.5 Containers shall be 15 m apart from any building or property or LP-gas or LN-gas plants.
- 3.5.19 Installation of non-refrigerated containers shall comply with the Gulf Standard mentioned in item 2.1. To minimize possibilities of trespassing and tampering the area of LP-gas operation, any of the following methods shall be employed:
 - 3.5.19.1 Fencing or enclosure to 1.8 m high with at least two emergency exits.
 - 3.5.19.2 Suitable locking devices.
 - 3.5.19.3 Locks with frangible shanks.

3.5.20 Installation of Refrigerated Containers

General provisions for installation shall comply with the Gulf Standard mentioned in item 2.1. In addition the following shall also apply:

- 3.5.20.1 If liquid can reach outside the wall material by spill, material shall withstand – 42°C.
- 3.5.20.2 For product storage at less than minus 1°C the foundation design or container bottom insulation shall be such that damage from frost will be prevented. Ambient heat or supplied heat may be used.
- 3.5.20.3 If natural gas is used to purge any insulation space, it shall be vented to a safe location.